This paper is devoted to an investigation of the IR spectra and structure of polybutylene terephthalate (PBTP) — a representative of a series of complex polyethers with the general structural formula

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Polybutylene terephthalate (n = 4) has been studied rather fully by x-ray diffraction analysis. It has been established that conformational transformations and polymorphism of the crystal structures are characteristic for it and for other representatives of this series [1-10]. Polybutylene terephthalate crystallizes in two crystalline modifications, viz., α and β. Both modifications are triclinic and differ only with respect to the conformation of the methylene fragments of the macromolecules, viz., a trans orientation in the β form and a gauche-trans-gauche orientation in the α form. The α crystalline modification of the polymer is realized under the usual conditions of crystallization of PBTP; the β crystalline modification in pure form is observed only under conditions of deformation of the samples, and it is converted to the α form when the deforming action is removed. It hence follows that the activation barriers to transition between these structures are small, and the possibility of their coexistence is determined by the degree of stabilization of these conformations.

The IR absorption spectra of PBTP were studied in [11-14], in which data on the positions and assignment of the bands were presented, and an unequivocal relationship between the α and β phases of PBTP, identified by x-ray diffraction analysis, and the corresponding bands in its spectra was established. Conformation-sensitive bands of the α phase at 760, 917, and 1460 cm\(^{-1}\), of the β phase at 960 and 1470 cm\(^{-1}\), and of the amorphous state of the polymer at 937 cm\(^{-1}\) were isolated in the spectrum of the polymer.

EXPERIMENTAL CONDITIONS

The investigated polymer was obtained in the form of thin layers from the melt or from a solution in tetrachloroethane (TCE) (the concentration of the solution was 0.5% by mass) on the surface of both low-energy (Teflon) and high-energy (NaCl and KBr) supports. Since
Fig. 1. Fragments of the IR absorption spectra of polybutylene terephthalate: 1) layer of a melt cooled abruptly in liquid nitrogen; 2) layer of the polymer on Teflon cooled slowly from the melt; 3) layer of the polymer formed on a single-crystal KBr chip.

Fig. 2. Changes in the relative intensities of the ordered state of PBTP (760, 812, and 917 cm⁻¹) and of the amorphous state (937 cm⁻¹) on the arbitrary scale 1-8, where points 1-4 on the axis of abscissas pertain to the different methods of crystallization of the polymer on a Teflon surface, and points 5-8 pertain to crystallization on a KBr surface.

the character of the change in the spectra was identical for both supports, we made systematic measurements only for the KBr support. Single-crystal KBr chips (the [001] plane) were prepared immediately prior to application of a solution of the polymer on their surface. The polymeric layers obtained from the solution in the case of both KBr and Teflon supports were applied under conditions of isothermal crystallization at 383 and 413 K. For each of them, prior to application of the layers, the solution of the polymer and the supports were thermostatted for 30 min in a U-10 ultrathermostat. After application of the layers, the appropriate temperature was maintained for 1.5 h, after which slow cooling of the samples in the thermostat due to natural heat exchange occurred. The samples were also annealed at 473 K for 4 h in a vacuum desiccator at a pressure of 9.8·10² Pa. The PBTP samples for the investigation were prepared by the following methods (methods 1-4 were used for Teflon, and methods 5-8 were used for KBr surfaces): 1) abrupt cooling of the melt in liquid nitrogen; 2) isothermal crystallization from solution at 413 K; 3) isothermal crystallization at 383 K; 4) slow cooling of the polymer melt between Teflon gaskets; 5) isothermal crystallization from solution at 413 K; 6) annealing of these samples; 7) isothermal crystallization from solution at 383 K; 8) annealing of these samples. The IR absorption spectra were recorded with a UR-20 spectrometer.

RESULTS AND DISCUSSION

In the investigation of the IR absorption spectra of layers of PBTP formed on low- and high-energy supports we evaluated the effect of these surfaces on crystallization and conformational rearrangement of the polymer in the boundary layers. The changes in the PBTP